[001] VARIABLE-SPEED GEARBOX WITH TWO COUNTERSHAFTS

[002]

[003]

[004] The invention concerns a gearbox with two countershafts for power distribution according to the preamble of claim 1.

[005]

[006] Modern, powerful vehicle gearboxes usually comprise a main transmission group with a multi-stage basic gear and an upstream or downstream splitter group and/or a downstream range gear group. In a gearbox housing, they mainly comprise an input shaft as a first shaft and a central or main shaft as a second shaft, which can also be the output shaft, as well as one or more countershafts. The input and main shafts are essentially concentric with one another.

[007] Having regard to the running properties and smooth running, such gearboxes can be designed with helical gearing, at least for the forward driving range. The axial forces from the helical gearing have to be taken up by an axial bearing and transmitted to the housing.

[008] Gearboxes with the structure described can have one or more countershafts.

[009] In gearboxes with power distribution between two countershafts, the main transmission group comprises two shafts arranged essentially one behind the other, one of which, namely either the input shaft or the main shaft of the main transmission, is mounted radially and axially fixed, while the respective other shaft is mounted floating laterally, i.e., able to move radially to allow the necessary load equalization. In this, care should be taken that an easy swivelling motion of the floating shaft is possible.

[010] In gearboxes with two countershafts, the load equalization can preferably be designed such that the input shaft is mounted fixed on the housing, the countershafts are fixed on the housing and the main shaft is mounted floating in the gear wheels involved in the force flow.

[011] The known variable-speed gearboxes for goods vehicles have a three- or four-speed main or basic transmission section and an upstream or downstream splitter transmission as an auxiliary transmission, which doubles the number of gear speeds of the main transmission since it splits the transmission ratio steps of the main transmission. A range-change transmission downstream from the main transmission extends the ratio range of the main transmission. The range-change transmission can be in the form of a planetary gearset or in the form of an arrangement of spur gear wheels.

[012] From EP-A1 0 009 775 a range-change transmission with spur gear wheels downstream from a main transmission with two countershafts for power distribution is known. The range-change transmission has two countershafts which are rotationally independent of the countershafts of the main transmission. A floating gear wheel is arranged on the main shaft of the gearbox, which meshes with a gear wheel on each of the countershafts of the range-change transmission. This gearbox does not have sufficient capacity for absorbing axial forces that result from the gearing.

[013] From DE-A1 196 04 824 by the present Applicant, a variable-speed gearbox with a range-change transmission of planetary design has become known. On the gearing of the planetary transmission pressure combs are provided to take up the axial forces that result from the helical gearing. The content of DE-A1 196 04 824 is intended to be fully incorporated in the present application.

[014] The purpose of the present invention is to improve the axial mounting in a gearbox with two countershafts for power distribution.

[015] This objective is achieved by a variable-speed gearbox having the characteristics of Claim 1. Various design features are the object of the subordinate claims.

[016]

[017] In a range-change transmission with spur gears, the gear wheel arranged on the main shaft, which meshes with gear wheels on the countershafts of the range-change transmission, reaches very high rotation speeds in the disengaged condition in the fast shift position of the range-change transmission. This makes

mounting with axial bearings problematic. Accordingly, the invention proposes a variable-speed gearbox with a main transmission arranged in a housing and a downstream range-change transmission, in which the range-change transmission comprises power distribution to two countershafts and in which a gear wheel is arranged in a radially displaceable manner on a main shaft of the main transmission. This gear wheel meshing in each case with a first gear wheel on each respective countershaft and in which a drive output shaft is arranged radially and axially fixed in the housing of the variable-speed gearbox; to that shaft is connected a gear wheel which meshes in each case with a second gear wheel on each respective countershaft. Pressure combs are provided by way of a gear wheel on the main shaft which meshes with the first gear wheels of the countershaft is maintained in its axial position relative to the drive output shaft. More preferably, the countershafts are maintained in their axial position relative to the drive output shaft by way of pressure combs.

[018] In a particularly advantageous embodiment of the invention, the gear wheel on the drive output shaft comprises pressure combs which are in contact with pressure combs formed on the second gear wheels of the countershafts in order to take up axial forces. The gear wheel on the main shaft has pressure combs which are in contact with pressure combs formed on the first gear wheels of the countershafts in order to take up axial forces.

[019] Particularly advantageous is the drive output shaft, held radially and axially in the housing by a double conical-roller bearing arrangement.

[020] In another advantageous embodiment, the countershafts have only one radial mounting in the housing, which preferably comprises roller bearings.

[021] The countershafts and the gear wheel on the main shaft are guided and maintained axially with the help of the pressure combs. The lubrication of the pressure combs can take place from outside and is simple and effective. During the torque transmission by the gear wheels of the countershafts, no axial gear forces have to be taken up by the bearings and transferred to the housing. Thus, the axial mounting of the countershafts can be omitted and the countershafts need only be held in radial-mounting roller bearings. The entire gearset combination of

the range-change transmission is fixed axially by the mounting of the drive output shaft.

[022] Exact formation of the pressure combs on the gear wheel of the main shaft ensures that while the axial fixing is maintained, the necessary radial freedom of the movement is secured.

[023]

[024] The invention will now be explained in more detail with reference to a drawing.

[025]

[026]

[027] In Fig. 1, in a variable-speed gearbox (not illustrated in greater detail), a main transmission 2 comprises a main shaft 4, at the end of which is arranged a gear wheel 6 with some radial play. For this, the radial mounting of the gear wheel 6 is provided with its outer teeth engaging only in the outer teeth of two first gear wheels 8 and 10. In each case, the first gear wheels 8 and 10 are fixedly arranged on respective countershafts 12 and 14 or formed as one piece with the countershafts. Each countershaft 12, 14 has a respective second gear wheel 16 and 18, in each case again fixed on its countershaft 12 and 14 or made as one piece with the countershafts 12, 14.

[028] With their outer teeth, the two second gear wheels 16 and 18 mesh with the outer teeth on a gear wheel 20 arranged fixed on a drive output shaft 22 of the variable-speed gearbox or made as one piece therewith. To the drive output shaft 22 is attached a drive output flange 24 by which the variable-speed gearbox is connected to further elements of a vehicle drive train (not illustrated here).

[029] The drive output shaft 22 is mounted by two conical-roller bearings 26 and 28 in a housing 30 of the variable-speed gearbox or of a range-change transmission 32 downstream from the main transmission 2. Also mounted in the housing 30 are the two countershafts 12 and 14, each in two roller bearings 34, 36 and 38, 40 respectively. These roller bearings 34, 36, 38, 40 only take up radial forces and transfer them to the housing 30. All the gear teeth of the gear

wheels 8, 10, 16, 18, 20 are of the helical-tooth type from which axial forces result for the absorption and transfer of which the roller bearings 34, 36, 38, 40 are not suitable.

[030] A gearshift sleeve 42 is arranged at the end of the main shaft 4 is which, by virtue of inner teeth, is connected with the main shaft 4 rotationally fixed but able to be displaced axially. By way of a control mechanism (not shown here), the gearshift sleeve 42 can be moved axially. When this happens, the gearshift sleeve 42 with its outer teeth 48 connects the main shaft 4 either with inner teeth 44 on the gear wheel 6 on the main shaft 4 or with inner teeth 46 of the drive output shaft 22 to form a direct connection between the main shaft 4 and the drive output shaft 22. If desired, the gearshift sleeve can also adopt a neutral shift position in which there is no connection with either of the inner teeth sets 44, 46.

[031] The drive output shaft 22 is mounted axially fixed in the housing 30 by means of the conical-roller bearings 26 and 28. Laterally on the outer teeth of the gear wheel 20 on the drive output shaft 22 respective pressure combs 50 and 52 are arranged. The pressure surfaces on the pressure combs 50 and 52 react with correspondingly formed pressure surfaces on the gear wheels 16 and 18, thereby fixing the countershafts 12 and 14 in the axial direction. Thereby, the gear wheels 8 and 10 on the countershafts 12 and 14 are also fixed axially.

[032] Laterally on the outer teeth of the gear wheel 6 on the main shaft 4, respective pressure combs 54 and 56 are arranged. The pressure surfaces on the pressure combs 54 and 56 react with correspondingly formed pressure surfaces on the gear wheels 8 and 10 on the countershafts 12 and 14. Since the gear wheels 8 and 10 are axially fixed, as described above, the gear wheel 6 is also axially fixed by virtue of the pressure combs 54 and 56 so that the problems associated with axial mounting at high rotation speeds of the gear wheel 6 are eliminated.

Reference numerals

2	main transmission
4	main shaft
6	gear wheel
8	gear wheel
10	gear wheel
12	countershaft
14	countershaft
16	gear wheel
18	gear wheel
20	gear wheel
22	drive output shaft
24	drive output flange
26	conical-roller bearing
28	conical-roller bearing
30	housing
32	range-change transmission
34	roller bearing
36	roller bearing
38	roller bearing
40	roller bearing
42	gearshift sleeve
44	inner teeth
46	inner teeth
48	outer teeth
50	pressure comb
52	pressure comb
54	pressure comb
56	pressure comb